

PATENT APPLICATION
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Guido SCHAFFNER, Renato ANDORF
and Carsten PLOG

Appln. No.:

Filed: July 24, 2001

For: PROCESS FOR DENITRIFICATION AND EXHAUST GASSES,
PARTICULARLY FOR LEAN OPERATED INTERNAL COMBUSTION ENGINES

Attorney Docket No.: 3926.030

PRELIMINARY AMENDMENT

Box: PATENT APPLICATION
Honorable Commissioner of
Patents and Trademarks
Washington, D.C. 20231

Sir:

Prior to examination of the above-identified application,
please amend the application as follows:

Replacement pages 1, 3 and 5 are provided wherein the
following amendments are made in the specification:

IN THE SPECIFICATION:

Page 1, before paragraph [0001] insert:

BACKGROUND OF THE INVENTION

Field of the Invention

Page 1, paragraph [0001], lines 2-3, delete "according to
... Claim 1".

Page 1, before paragraph [0002] insert:

Description of the Related Art

Page 3, before paragraph [0008] insert:

SUMMARY OF THE INVENTION

20010724 40021650

Page 3, delete paragraph [0009] in its entirety.

Page 5, before paragraph [00016] insert:

BRIEF DESCRIPTION OF THE DRAWINGS

Page 5, before paragraph [00017] insert:

DETAILED DESCRIPTION OF THE INVENTION

IN THE CLAIMS:

Page 8, line 1, please delete "PATENT CLAIMS", delete claims 1-8 and add the following new Claims 9-16:

WHAT IS CLAIMED IS:

9. Process for denitrification of exhaust gasses of an internal combustion engine operated primarily in the lean phase including the following process steps:
- placing in the exhaust gas stream of the internal combustion engine a nitrogen oxide storing and catalytically effective solid which is free of alkali earth metals, alkali metals and rare earth, comprising
 - (a) a porous carrier substance and
 - (b) rhodium, which is provided on the porous carrier substance,
 - storing nitrogen oxide during the lean motor operating phase with an air/fuel ratio $\lambda > 1$,
 - releasing and catalytically converting the nitrogen oxide during the rich motor operating phase with an air/fuel ratio $\lambda > 1$,

wherein the porous carrier substance is comprised of at least 50 wt.% zirconium oxide, titanium oxide, silicon oxide or a zeolite or a mixture of two or more of these compounds.

10. Process according to Claim 9, wherein a second noble metal, for example Pt, Pd, or Ir, or a mixture of noble metals, is provided upon the porous carrier substance.
11. Process according to Claim 9, wherein the solid is in the form of a pellet or extrudate, or is provided upon a geometric carrier.
12. Process according to Claim 9, wherein the noble metals are provided as atomic mixture upon the porous carrier substance.
13. Process according to Claim 9, wherein the noble metals are respectively individually applied upon the same or different porous carrier substances.
14. Process according to Claim 13, wherein the noble metals are respectively individually applied upon the same or different porous carrier substances to form a powder mixture.
15. Process according to Claim 13, wherein the respective noble metals applied on identical or different porous carrier substances are provided upon a geometric carrier in layers.
16. Process according to Claim 14, wherein the noble metals are respectively applied individually upon the same or different porous carrier substances are provided separately from each

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U.S. Application No.
PRELIMINARY AMENDMENT

Attorney Docket: 3926.030

EXPRESS MAIL CERTIFICATE

"EXPRESS MAIL" MAILING LABEL NUMBER: EL435909455US

DATE OF DEPOSIT: July 24, 2001

I HEREBY CERTIFY that the foregoing PRELIMINARY AMENDMENT is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated and is addressed: **ATTN: BOX PATENT APPLICATION, Commissioner of Patents and Trademarks, Washington, D.C. 20231.**

The Commissioner is hereby authorized to charge any additional fees which may be required at any time during the prosecution of this application without specific authorization, or credit any overpayment, to Deposit Account Number 16-0877.


Bonnie L. Horst

PROCESS FOR DENITRIFICATION OF EXHAUST GASSES,
PARTICULARLY FOR LEAN OPERATED INTERNAL COMBUSTION ENGINES

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The invention concerns a process for denitrification of primarily lean operated internal combustion engines.

Description of the Related Art

[0002] EP 0 890 389 A1 discloses an NOx storage catalytic converter for cleansing the exhaust gasses of vehicle exhaust gas systems. The disclosed storage catalytic converter is comprised of two material components, wherein the one material component serves for intermediate storage of nitrogen oxide during lean operation of the vehicle internal combustion engine and the other material component is a catalytic material with three-way characteristics in which, during short term rich exhaust gas operation, stored nitrogen oxide is released and converted to molecular nitrogen (N₂).

[0003] The required relationship between the lean operating phase and the rich operating phase in the combustion control of the vehicle internal combustion engine is determined by various parameters such as the NOx storage capacity of the material, the amount of NOx arriving, the exhaust gas temperature and, in the case of sulfur-containing exhaust gas, by the sulfur content. In order to achieve a low fuel consumption, it is desired to operate the vehicle internal combustion engine as long as possible with lean operating phases and as briefly as possible with rich operating phases. The NOx storage catalytic converter thus operates discontinuously, since the combustion control of the exhaust gas must be switched alternately from lean to rich.

[0004] EP 0 707 882 A1 discloses an NOx storage catalytic converter with an aluminum oxide containing carrier, upon which a

Variable	Mean	SD	Min	Max
Age	38.5	12.5	25	65
Gender				
Male	55.2	5.1	45	65
Female	44.8	5.2	35	55
Marital Status				
Married	68.5	6.5	55	85
Single	31.5	7.5	15	45
Education				
High School	15.2	2.5	10	20
College	35.8	3.5	25	45
Postgraduate	49.0	4.5	35	65
Income				
Low	12.5	3.5	5	20
Medium	45.2	5.5	30	60
High	42.3	6.5	25	55
Occupation				
Manager	25.5	4.5	15	35
Professional	35.2	5.5	25	45
Service	39.3	6.5	25	55
Unemployed	10.0	2.5	5	15
Health Status				
Good	65.5	5.5	55	75
Fair	30.0	6.5	15	45
Poor	4.5	2.5	0	10
Stress Level				
Low	15.2	3.5	5	25
Medium	45.5	5.5	30	60
High	39.3	6.5	25	55
Life Satisfaction				
High	65.5	5.5	55	75
Medium	30.0	6.5	15	45
Low	4.5	2.5	0	10

Variable	Mean	SD	Min	Max
Age	38.5	12.5	25	65
Gender				
Male	55.2	5.1	45	65
Female	44.8	5.2	35	55
Marital Status				
Married	68.5	6.5	55	85
Single	31.5	6.5	15	45
Education				
High School	15.2	2.1	12	18
College	35.8	3.2	25	45
Postgraduate	49.0	4.0	35	65
Income				
Low	25.5	5.5	15	35
Medium	45.5	6.5	35	55
High	29.0	5.0	20	40
Occupation				
Manager	35.2	4.2	25	45
Professional	45.8	5.8	35	55
Service	19.0	3.0	10	30
Unemployed	0.0	0.0	0	0
Health Status				
Good	65.5	7.5	55	75
Fair	34.5	7.5	25	45
Poor	0.0	0.0	0	0
Smoking Status				
Smoker	35.2	5.2	25	45
Nonsmoker	64.8	5.2	55	75
Alcohol Consumption				
Regular	15.5	3.5	10	25
Occasional	35.5	4.5	25	45
Never	49.0	4.0	35	65

Variable	Mean	SD	Min	Max
Age	38.5	12.5	25	65
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Occupation				
Manager	25.5	4.5	15	35
Professional	35.2	5.5	25	45
Service	39.3	6.5	30	50
Unemployed	10.0	2.5	5	15
Health Status				
Good	65.5	5.5	55	75
Fair	30.0	6.5	20	40
Poor	4.5	2.5	0	10
Stress Level				
Low	15.2	3.5	5	25
Medium	45.8	5.5	30	60
High	38.5	6.5	25	50
Life Satisfaction				
High	65.5	5.5	55	75
Medium	30.0	6.5	20	40
Low	4.5	2.5	0	10

Variable	Mean	SD	Min	Max
Age	38.5	12.5	25	65
Gender				
Male	55.2	5.1	45	65
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Marital Status				
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Education				
High School	15.2	2.1	12	18
College	35.8	3.5	25	45
Postgraduate	49.0	4.0	35	65
Income				
Low	12.5	3.2	5	20
Medium	45.0	5.5	30	60
High	42.5	6.0	25	55
Health Status				
Good	65.0	7.0	50	80
Fair	30.0	6.0	15	45
Poor	5.0	2.0	0	10
Stress Level				
Low	10.0	2.0	5	15
Medium	40.0	4.0	25	55
High	50.0	5.0	35	65
Life Satisfaction				
High	60.0	8.0	45	75
Medium	35.0	6.0	20	50
Low	5.0	2.0	0	10

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Stress Level				
Low	10.0	2.0	5	15
Medium	40.0	4.0	25	55
High	50.0	5.0	35	65
Life Satisfaction				
High	60.0	8.0	45	75
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High	50.0	5.0	35	65
Life Satisfaction				
High	60.0	8.0	45	75
Medium	35.0	6.0	20	50
Low	5.0	2.0	0	10

[00015] The inventive process is particularly suitable for employment in internal combustion vehicle motors, and in particular diesel motors, stoichiometrically and lean operated Otto motors, as well as gas motors.

BRIEF DESCRIPTION OF THE DRAWINGS

[00016] The invention will be described in greater detail below on the basis of the experimental results with reference to the figures. There is shown:

Fig. 1 the temperature-dependent NO_x conversion of an inventive Pt/Rh/ZrO₂-solid in λ -alternating operation,

Fig. 2 the NO_x concentration over time using the inventive Pt/Rh/ZrO₂-solid at T=280°C in λ -alternating operation.

DETAILED DESCRIPTION OF THE INVENTION

[00017] During the experiments a lean operating phase of 90 seconds was alternated with a rich operating phase of 4 seconds. The reaction-gas had the following compositions in the lean and rich operating conditions:

	Lean ($\lambda=2.4$)	Rich ($\lambda=0.7$)
NO	280 Vol.-ppm	280 Vol.-ppm
O ₂	12.5 Vol.-%	0 Vol.-%
CO	0.25 Vol.-%	9.3 Vol.-%
H ₂	1500 Vol.-ppm	2.6 Vol.-%
Propene	75 Vol.-ppm	2700 Vol.-ppm
CO ₂	10 Vol.-%	10 Vol.-%
H ₂ O	10 Vol.-%	10 Vol.-%
N ₂	Rest	Rest